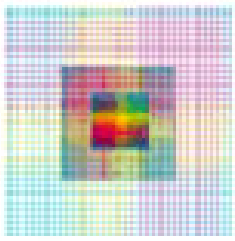

AUDIT II

Country Report

GREECE

Konstantinos Lytras, Loukas Gavriil

Final Report 31.08.2002

SUMMARY OF ENERGY AUDITING

Energy Audit Programmes

No pure Energy Audit Programmes (EAPs) exist, at the moment, in Greece, which fulfil all the criteria set for an integrated EAP on a national level.

Other Programmes with Energy Audits

Operational Programme for Competitiveness (OPC) 2000-2006

The OPC 2000-2006 is an integrated multi-sector (industry/services, energy, tourism, R&TD) national programme for regional development within the EU 3^{d} Community Support Framework (CSF) for the Regions of Greece. OPC financially supports private energy investments in industry and services as well as sectoral pilot energy projects in both the public and private sectors within specific implementation schemes (voluntary agreements, TPF/EPC).
Private energy investments involve energy audits in two stages. At the first stage, energy audits, processed by expert consultants, consist an obligatory element of the documentation supporting the energy and economic analysis of an existing site profile and of the potential of eligible measures, which are being proposed for application and subsidy. This type of audit is also subsidised. At the second stage, verification energy audits are applied in the site of every energy project already implemented through OPC. This auditing procedure is realised by the auditors of the intermediate Management Agents of OPC within a period from project completion in order to verify quantified energy saving targets calculated previously at the project proposal stage.
Energy audits, at the proposal stage of a private energy investment, should follow the model specifications and procedures of the official Regulation for Energy Audits issued on 1999. (JMD GG 1526/B/27-7-99). The Regulation perceives energy auditing as an integral part of energy management and energy saving studies and deals with the model procedures and methodology for walk-through and extended diagnostic energy audits in industrial and building sites. In the medium term, only accredited energy auditors and auditor companies will service energy audits, according to the Regulation. Accredited energy auditors will be registered to special records of the Ministry of Development in relation to specific criteria and experience.
CRES has performed, within OPC infrastructure activities, energy audits in 25 pilot public buildings of different types – use (e.g. administration, hospitals, educational/sport, airport), throughout the country, within the provisions of OPC for financial support of proposed energy saving measures for those buildings.

CRES Energy Bus

Since 1990, the Centre for Renewable Energy Sources (CRES) has used the facility of the Energy Bus to perform energy audits of industrial and tertiary (commercial/public) sector end-energy user sites. CRES Audits are effected within energy efficiency programmes or unitary projects on a non-profit basis and are usually co-financed, either by the European Commission energy related or regional development programmes and the associated government budget, or by private third party capitals and public administration funds. The application of well organised energy auditing activities has been dictated from the ascertainment of the need to promote energy efficiency policy and applications in

Greece taking into account the local circumstances where adequate energy indices and data for all final consumption sectors is still missing.
The goals of CRES energy auditing activities with the use of its Energy Bus infrastructure is the promotion of RUE/Energy Saving and the formulation of energy consciousness. The objective of CRES Energy Bus audits is the recording, through adequate on-site measurements, of final energy consumption per use, process, department or plant as well as the identification and quantification of thermal and electrical energy losses. Energy recordings are followed by a brief with the audit client and an audit report, regarding the results of energy measurements and the appropriate proposals for energy savings on site.
The subsequent benefits are the promotion of energy saving strategies and investments for the end-energy users as well as the extraction and analysis of useful data as a background for sectoral national energy policies. Since 2000, the facility of Energy Bus has been incorporated to the CRES Laboratory of Evaluation of RES & RUE Technologies, to be accredited by EN 45001.

JMD 21475/4707/98 & Regulation for RUE in Buildings (KOXEE)

Since 1998, the Joint Ministerial Decision (JMD) 21475/4707 for the improvement of energy efficiency of buildings to limit CO_2 emissions, instituted obligatory energy auditing activities for public buildings. These activities are to be coordinated by officially established Energy Management Offices of public administration and performed according to the new Energy Audit Regulation (EAR). Furthermore, mandatory energy auditing activities, performed by independent experts to be authorized by a ministerial Experts Committee, are foreseen for the support of model building energy certification and rating procedures, mandated by the new Regulation for RUE in Buildings (named KOXEE) which will be shortly issued (2002).

Action Programme for Energy Efficient Public Buildings within CSF 2000-2006

In 2001, a targeted Action Programme, of the Ministry of Environment and CRES was announced. This programme is designed to promote the integrated energy efficient design in public building projects which will be proposed, financed and implemented within the EU 3^{d} Community Support Framework (CSF) 2000-2006 for the Regions of Greece. Energy auditing activities, to be performed by auditors, coordinated by CRES, are foreseen during the planned final stage of this programme, in order to support and verify energy technology investments. Such investments are planned for financial support through the OPC 2000-2006 via special support schemes which would incorporate the Third Party Financing (TPF)/Energy Performance Contracting (EPC) mechanism.

Other Activities including Energy Audits

The recent institutional framework for energy and the environment in Greece promotes alternative or complementary commercial energy auditing activities to support environmental management and certification schemes (e.g., EMAS) as well as economic activities associated with intensive energy end-use or energy services provided by specialised companies (e.g. Energy Service Companies) (ESCOs) through novel financial mechanisms (i.e. Third Party Financing (TPF), Energy Performance Contracting (EPC).

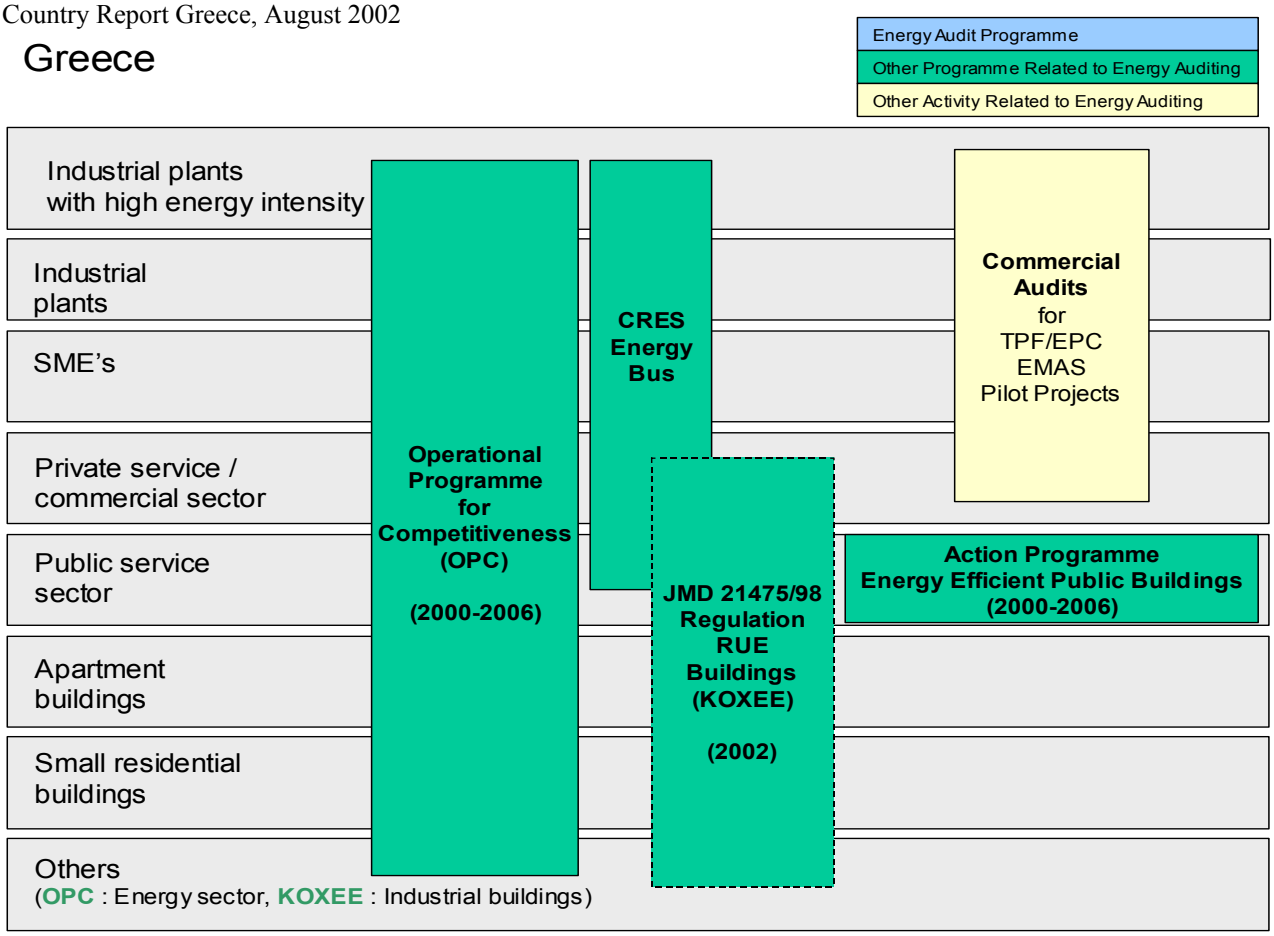

Figure 1. The Map of energy audits in Greece

Table of EAP features coverage:

	Operational Programme for Competitiveness (OPC)	**CRES Energy Bus**	**JMD 21475/98 Regulation RUE Buildings (KOXEE)**	**Action Programme for Energy Efficient Public Buildings**
Status	2000-2006	1990-	2002-	2000-2006
Administration	Ministry of Development - OPC Management Service	Centre for Renewable Energy Sources (CRES)	Ministry of Environment Ministry of Development	Ministry of Environment Ministry of Development
EA models	+++	++	++	+
Auditors' tools	++	++	++	++
Training, authorisation	++	++	++	
Quality control	+++	+	+	
Monitoring	+++		+	
Volumes, results	+++	+	+	+
Evaluation	+++			

+++ = Detailed information available
++ = Some information available
+ = Very little information available
= No information available / does not exist

Contacts

General information	Konstantinos Lytras	CRES 19th Km Marathonos Avenue Pikermi GR 19009 Greece	+30 10 66 03 293	klytras@cres.gr www.cres.gr
Operational Programme for Competitiveness (OPC)	Nikos Diakoulakis Eleni Kritikou	Ministry of Development- OPC Management Service 56 Mesogion Avenue Athens GR 11527 Greece	+30 10 74 50 800 +30 10 74 50 817	infoepan@mou.gr elenkrit@mou.gr www.antagonistikotita.gr www.ypan.gr
CRES Energy Bus	George Kamaras	CRES 19th Km Marathonos Avenue Pikermi GR 19009 Greece	+30 10 66 03 290	kamaras@cres.gr www.cres.gr
JMD 21475/98 KOXEE Regulation	Argyro Dimoudi Konstantinos Lytras	Ministry of Environment Directorate of Building Policy 36 Trikalon str. Athens GR 11526 Greece CRES	+30 10 69 10 667 +30 10 66 03 293	a.dimoudi@dopk.minenv.gr www.minenv.gr klytras@cres.gr
Action Programme Energy Efficient Public Buildings	Konstantinos Lytras	CRES 19th Km Marathonos Avenue Pikermi GR 19009 Greece	+30 10 66 03 293	klytras@cres.gr www.cres.gr

Country Report

Country Report written by	Konstantinos Lytras Loukas Gavriil	Centre for Renewable Energy Sources (CRES)
Based on the documentation and views of	Senior Experts	CRES – Intermediate Agent of OPE 1994-1999 (IAOPE) Ministry of Development

Disclaimer

The information contained in this report has been gathered from publicly available sources and through expert contacts. All efforts have been made to secure the veracity of the report, however the authors cannot fully guarantee the content.

THE COUNTRY REPORT

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1. Background and Present National Policy

1.1 Previous activities

Organised energy auditing activities in Greece have been broadly implemented during the last decade, initially on a pilot demonstration, training and end-user awareness basis and later within a certain framework for programme or service design, support and results verification. Energy auditing aimed also at the establishment of structured sectoral energy policies through the provision of proper energy indices for benchmarking and of scaled energy saving opportunities. Many well-respected energy audits have used, from the late 80s and mainly after 1990, the facility of an Energy Bus for the associated measuring, evaluation and promotion activities.

The process of well-organised energy auditing activities was dictated from the ascertainment of the urgent need to promote energy efficiency policy and applications in Greece. CRES procured its Energy Bus infrastructure in 1991. In the beginning, the Energy Bus facility implemented pilot energy audits to several sites of the public and private sector (large industries, SMEs, hospitals, hotels, public office buildings etc.). Another non-profit public organisation, the Greek Productivity Center (GPC - ΕΛΚΕΠΑ) was involved, up to 1996, in energy auditing activities with the use of an Energy Bus, as part of the services provided by its Institute for Technological Applications (ITA - ITE). The almost 100 energy audits effected by the GPC with its Energy Bus used a complete instrumentation infrastructure and followed a similar to CRES energy audits, procedure.

After the mid 90s the new era for energy auditing activities in Greece began through the launch of the Operational Programme for Energy (OPE) 1994 - 1999 within the second (2nd) Community Support Framework (CSF II) for Greece. OPE has specified and financed formal energy auditing procedures to support and certify effective energy investments in the fields of Rational Use of Energy & Energy Saving (RUE & ES) as well as of Renewable Energy Sources (RES) in industry and the tertiary sector.

It is estimated that over 1.000 energy audits have already been implemented in various sites in Greece. Around 300 of them used the facility of an Energy Bus for the associated measuring and evaluation activities.

1.2 Present national energy policy

National actions are being implemented within Greek energy and environmental policy, from the early 90s, to face European and global conditions and cope with EU policy and projected scenarios regarding the energy supply, use and management in all economic sectors.

Following the basic goals of national energy policy for a) secure energy supply at a reasonable cost, b) enhanced market competitiveness and progressive liberalization c) environmental quality improvement and d) independence from external energy factors, the government has been engaged to adopt actions and programmes for the rational exploitation of indigenous energy sources including lignite and Renewable Energy Sources (RES), for the broad promotion of Rational Use of Energy (RUE), for the penetration of natural gas to all end-energy uses and for the application of cogeneration of heat and power (CHP).

Given the implementation of an ambitious and strict policy, the following positive results are expected:

- The restraint of the increase of national CO_2 emissions to 25 % of 1990 values, by the year 2010, as was officially agreed in the European Council regarding Kyoto Summit.
- The increase of the share of RES in the national energy balance from 5.4 % in 1996 to 8.2 - 8.5 % in 2010 especially due to wind energy and biomass applications.
- The enhancement of business development and employment opportunities in the field of RUE and RES technologies
- The creation of regional energy markets
- The reinforcement of the safety of energy supply

Energy auditing activities in Greece focus on the support of national and European energy efficiency and environmental policy and programmes, energy and environmental management and certification schemes as well as of the outsourcing of integrated services for the implementation of bankable energy projects. This policy gives priority to the improvement of the crticical indices of the national energy balance, such as energy intensity and to the reduction of adverse impacts of energy use to the environment. The government follows today an integrated approach for energy efficiency in the industrial and the building sectors by using a mix of measures, as follows:

- Financial instruments such as subsidies and special financial support schemes for investments in the industrial, services and domestic sectors, favourable tariffs paid to electrical power producers for the electricity generated by cogeneration (CHP) (or by on site-systems renewable energy sources), tax reductions for the installation of domestic natural gas and RES equipment
- Mandatory interventions under laws, directives, regulations and centrally coordinated action programmes regarding energy management in building sector, model procedures for energy audits, energy efficiency labelling in domestic appliances, billing of heating energy in buildings, etc.
- Master restructuring, new business plan, enhanced operations and continuous co-financing of the diverse activities of the Centre for Renewable Energy Sources (CRES).
- Administrative support and coordination, by CRES, of the regional activities for the promotion of energy efficiency issues, already performed by the 19 existing Regional, Prefectural and Municipal Energy Centres.

The present legislation which is the most relevant to energy auditing activities focusing on the increase of energy efficiency in industry and the building sector is summarised as follows :

a. Legislation for energy efficiency and the reduction of CO_2 emmissions in the building sector

The Joint Ministerial Decision (JMD) 21475/4707/98 for " the improvement of energy efficiency of buildings to limit their contribution to CO_2 emissions", has established, in compliance to the SAVE Directive 93/73/EEC, and on the basis of the results of the Ministry of the Environment Action Plan ENERGY 2001 (1995) a) the elaboration of a new national Regulation for the Rational Use of Energy in Buildings (named KOXEE) with novel criteria for the application of energy efficient technologies in the building design and refurbishment process, b) energy certification and labelling procedures, c) energy auditing activities according to the Energy Audit Regulation specifications for every new building (issued in the form of another legal act, the JMD GG 1526/B/27.7.1999), and d) Energy Management Offices and schemes within the organisational chart of every public administration service.

b. Legislation for business economic development

The Development Law 2601/98 on the support of private investments for the economic and regional development provides, among a broad variety of investment opportunities, financial support to industrial and tertiary sector companies for energy efficiency and RES investments via either direct investment, leased capital or interest subsidies, or tax exemptions and special support schemes.

c. Legislation for industrial energy management

Ministerial Council Acts (MCA) 16/79 and 237/80 and the Ministerial Decision (MD) 95066/3466/79 have obliged every industrial energy consumer with installed capacity of more than 500 HP to keep a special record-book with yearly energy balances and to reduce the standard mean yearly specific energy consumption through proper energy investments following well elaborated energy design studies which would determine the industrial consumer energy targets. Despite the obligatory mandates of the era, well organised energy auditing activities have in most cases never been properly completed during the last 20 years.

d. Legislation for energy efficient equipment and the environmental control of energy use in buildings

Presidential Decree 335/93 for the energy efficiency and energy labelling of new boilers fuelled by liquid and gaseous fuels (compliance with Directive 92/42/EEC)
Ministerial Decision 10315/93 regarding the control of the emissions (CO_2, O_2, smoke, flue gas temperature and energy losses etc.) from central heating boiler systems. This act has instituted emission minimum and maximum limits as well as obligatory regular boiler-burner-exhaust system inspection and maintenance procedures, performed by authorized professionals. The Ministerial Decision is going to be revised (2002) by a new one, compatible with the requirements of the Directive 92/42/EEC and PD 335/93 for boiler energy efficiency and of the JMD 21475/98 for energy auditing procedures in building systems.
Directive 89/106/EEC for the harmonisation of legislative, regulative and administrative issues among Member States concerning building construction products, as transferred by the PD 334/94. The essential requirements for energy efficiency and environmental quality have been incorporated as product selection criteria to the draft KOXEE.

e. Government Circulars for Energy Management and Energy Efficiency in public administration buildings

The Ministry of Interior and Public Administration, proceeded, in 1997, to the issue of two Circulars, addressed to the central and regional public administration, local authorities and public organisations. All public services should assign energy managers for their buildings with concrete responsibilities concerning technical, organisational and financial measures, including the promotion of energy auditing activities and the setting and follow up of TPF contracts, in order to improve energy efficiency as well as to introduce renewable energy sources mainly in the planning and design process of new buildings. Up to now, over 600 energy managers have already been appointed. Another Circular, which was issued by the Ministry of Development (2000), to boost the application of the JMD 21475/4707/98 in public administration, addressed CRES as the official State consultant and expert services provider (e.g. energy audits) for the support of public authorities regarding the establishment of energy management procedures in buildings.

2. Energy Audit Programmes

In Greece, there are no dedicated national or regional programmes dealing exclusively with energy audits. However energy-auditing activities consist an important element of several on-going national programmes or legislative and administrative acts for the improvement of energy efficiency and the establishment of energy management.

3. Other Programmes with Energy Audits

3.1 Operational Programme for Competitiveness (OPC)

3.1.1 Goals

The new OPC 2000-2006 is an integrated multi-sector (industry/services, energy, tourism, R&TD) national programme, within the EU 3rd Community Support Framework (CSF) for regional development. OPC aims at the increase of the competitiveness of the Greek economy thus securing the integrated development of all regions in the country. OPC is divided into nine Priority Axes and each axis includes several measures on a specific target. The Priority Axis 2 enhances and supports enterprising. The Measure 2.1 of Axis 2, entitled "Support of investments in CHP, RES and Energy Saving", financially supports energy investments in the energy sector, industry and services as well as sectoral pilot energy projects in both the public and private sectors within specific implementation schemes (voluntary agreements, TPF/EPC).

The goals of OPC Measure 2.1 are:

- The security of energy supply and the decrease in dependence from imported primary energy sources through the diversification of energy supply sources.
- The increase in the national added value
- The protection of the environment
- The support of the economic activities, the regional development and the employment

OPC energy related Axes and Measures are the successors of the OPE (Operational Programme for Energy) programme measures, that have been implemented during the previous period (1994-1999) within the EU 2nd CSF for Greece. OPE was presented in the AUDIT I project Country Report for Greece. The results obtained from the implementation of OPE were used for the planning of OPC structure and for setting out of quantitative targets. These targets refer to specific programme implementation, result and impact indicators and are presented in Table 3.1 :

Table 3.1. - Targets and Indicators of OPC Measure 2.1 for energy investments

	Target for 2006
A. Implementation indicators	
Installed electrical power from RES (MWe)	730
Installed electrical power from CHP (MWe)	200
Installed thermal power from RES except solar systems (MWth)	130
Installed thermal power produced from CHP (MWth)	400
B. Result Indicators	
Increase of the installed electrical power from RES and CHP (MWe)	930
Annually produced electricity from RES and CHP (GWhe)	3.400
Annually produced heat from RES and CHP (GWhe)	2.000
Annual substitution and saving of conventional primary energy (from CHP, RES and RUE), (GWh)	11.320
C. Impact Indicators	
Annual reduction of CO_2 emissions (ktons)	3.950
New permanent job vacancies (Number)	675
Enterprises involved to RES projects (Number)	160
Enterprises involved to energy saving and fuel substitution projects (Number)	360

3.1.2 Target sectors

During the completed OPE programme Measures for energy efficiency, cogeneration and renewable energy investments, energy auditing procedures had focused mainly to the energy industry, the large energy consumers of the industrial and tertiary sectors and the SMEs which proceeded to energy project investments subsidized by OPE, i.e. 331 energy projects (energy industry, industrial and commercial companies, private sector health-care, tourist and education facilities, large office buildings, private law bodies of central or local authorities, etc.). Today, the OPC Measure 2.1 targets also the domestic sector as well as the critical industrial branches and the public service sector for potential investments on energy saving. Special focus has been given to public sector investments, which may be enhanced through special financing schemes like TPF / Energy Performance Contracting. The public sector owned buildings appear to present a great potential for energy saving investments

3.1.3 Administration

The Ministry of Development (MIDE) centrally administers the whole OPC programme, and therefore the Measure 2.1 which is directly associated to energy auditing activities. For this reason a special public service unit, the OPC Management Service was formed (OPCMS). A MIDE Executive Secretary leads OPCMS, supervises all OPC programming, implementation control and evaluation activities. The OPC programme is monitored by the Monitoring Committee of OPC (MCOPC), which consists, among others, of all the General Secretaries of MIDE, the representative of OPCMS, the representative of the Ministry of Economy (MIEC) and representatives of various expert governmental organisations, such as CRES.

All OPC activities related to the proper implementation of energy investment projects, having been accepted for financial support, are co-ordinated by seven (7) regional operating agents of the programme, the so called Regional Intermediate Management Agents (IMAs) from the stage of proposal evaluation till the final hand-over of each completed project. During the proposal stage, energy audits should be implemented by experts of independent entities like private consulting companies or organisations of the public sector that should have the particular know-how. Energy auditing procedures at the final stage of hand-over for each project are managed and performed by the auditors of IMAs.

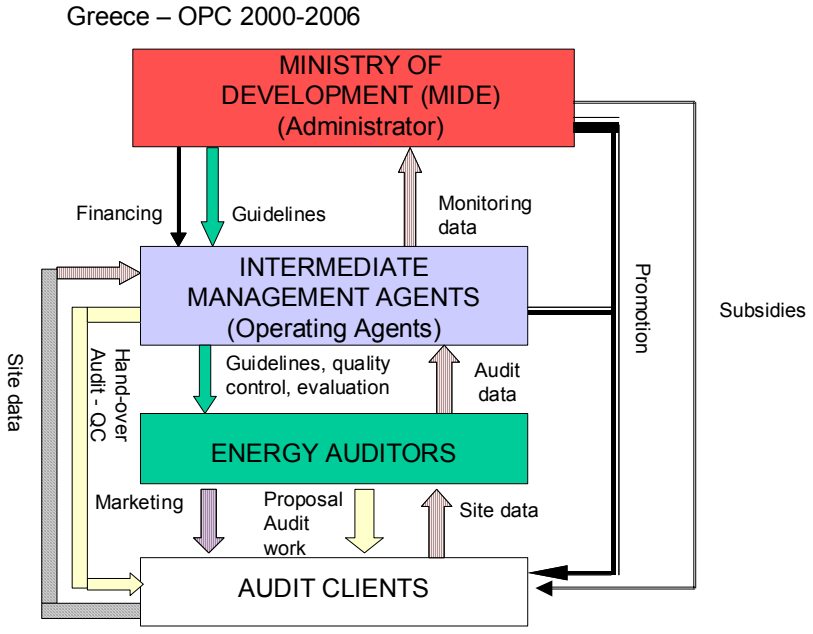

Figure 3.1 - OPC Administration Map for energy investments and audits

3.1.4 Implementing instruments

The OPC Measure 2.1 provides either financial incentives in terms of direct subsidies for unitary energy investments in the private sector or overall support through the design and implementation of novel management and financial schemes for pilot energy saving projects at the domestic sector, as well as for the the industrial and tertiary sector branches through Voluntary Agreements and the introduction of energy management (employment of energy managers and energy auditors, implementation of monitoring and targeting systems). Further schemes and projects are foreseen for

the public building sector via the implementation of Third Party Financing /Energy Performance Contracting mechanisms.

Energy auditing procedures within OPC Measure 2.1 support all the above mentioned actions. Specific energy auditing procedures are already performed within the framework of directly subsidized energy efficiency investments under Measure 2.1. The first procedure is the energy audit, which constitutes an obligatory element of the eligible activities included in the formal proposal for a future energy project. The audit work cost is also subsidised by 50% and may account up to 2% of the proposed total energy project budget. This audit work should also have followed the regulatory guidelines mandated by the Energy Audit Regulation (issued in the form of the Joint Ministerial Decision GG 1526/B/27.7.1999). The second procedure is the verification energy audit applied in the site of every energy project already implemented through OPC. This auditing procedure is realised by the auditors of the IMAs of OPC, within three (3) months from project completion, as stated in the project contract, in order, for the OPC management services, to verify quantified energy saving targets, which have been calculated previously at the project proposal stage.

Mandatory / legal schemes	**Voluntary schemes**
Energy audit model procedures are mandated by the Energy Audit Regulation (JMD GG 1526B/27-7-99). Energy project hand-over audits are an obligatory element of contractual process for subsidized energy projects	Audits are an integrated part of the process of Voluntary Agreement and Energy Performance Contracting schemes foreseen for the domestic, industrial and tertiary sector (emphasis in industrial branches and the public building sector)
Fiscal incentives (taxes)	**Fiscal incentives (subsidies)**
No direct link with the tax system. Energy Service Companies (ESCOs), which are involved to energy auditing, still receive same tax relaxation with any other	Subsidies for energy audits at the proposal stage of each project (50% of service cost)
Marketing oriented schemes	**Policy issues**
No special promotional instruments dedicated to energy audits but audits are indirectly promoted through broad, regular and well structured publicity activities which constitute an integral element for the promotion of OPC energy related issues (e.g. OPC web site, service support line, newsletter, public events, TV spots)	Energy Audits consist an integral element for OPC energy efficiency investments and overall schemes as also stated in the relevant national policy documents

3.1.5 Energy audit models

Energy audits, at the proposal stage of a private energy investment, should follow the model specifications and procedures of the official Energy Audit Regulation (EAR) issued on 1999. (JMD GG 1526/B/27-7-99). The EAR is characterised as innovative and follows in principle the respective international experience. Energy auditing is perceived as an integral part of energy management and energy conservation analysis and more broadly as a potential part of the ecological audit and environmental management. The Regulation covers the standard procedures for walk-through and extended-diagnostic energy audits in industrial and building sites, defined as follows:

Walk-through energy audits assess site energy efficiency and cost on the basis of energy bills-invoices and a short on-site autopsy without incorporating complex measurements. The walk-through energy audit may last somewhere between one and 10 days if the audit concerns a large industrial plant. The walk though energy audit is implemented by the following procedure:

- Personal interview with the technical staff of the site and collection of all the available data concerning the use and the consumption of energy
- Short on site inspection
- Analysis of energy data
- Issuing of energy audit report and evaluation of the proposed actions.

The output of the walk-through energy audit is to determine good housekeeping or/and minimum capital investment energy saving options of direct economic return. A further list of other energy saving opportunities often involving considerable capital is proposed on a cost-benefit basis.

Thorough - Diagnostic energy audits request a more detailed recording and analysis of energy and other site data. Usually is the follow-up of the walk-through energy audit but this is not obligatory. The first task of the extended energy audit is the accurate evaluation of energy consumption in different end-uses (e.g. heating, cooling, different processes, lighting etc.) and the different factors that affect it (e.g. material quality, climatic conditions, quality and quantity of production or services). The second task of the thorough-diagnostic energy audit is to determine all the cost and benefits for the energy saving opportunities that meet the criteria and requirements of the end-energy site administration. A list for potential capital-intensive energy investments requiring more detailed data acquisition and processing is also provided together with an estimation of the associated costs and benefits. The thorough-diagnostic energy audit is implemented through the following procedure:

- Design of the energy audit
- Collection of available energy and production data
- On site inspection of the plant
- Implementation of measurement campaign
- Calculation of energy and mass balances
- Determination of possible actions for energy management improvement
- Determination of possible actions with short-term results
- Determination of possible actions with medium-term results
- Determination of possible actions with long-term results
- Issuing of energy audit report

The EAR includes specific chapters with detailed analysis of the related methodological steps and provides case studies of walk-through and extended - diagnostic audits as well as the criteria for the assessment of energy saving opportunities and the design principles of an energy conservation programme.

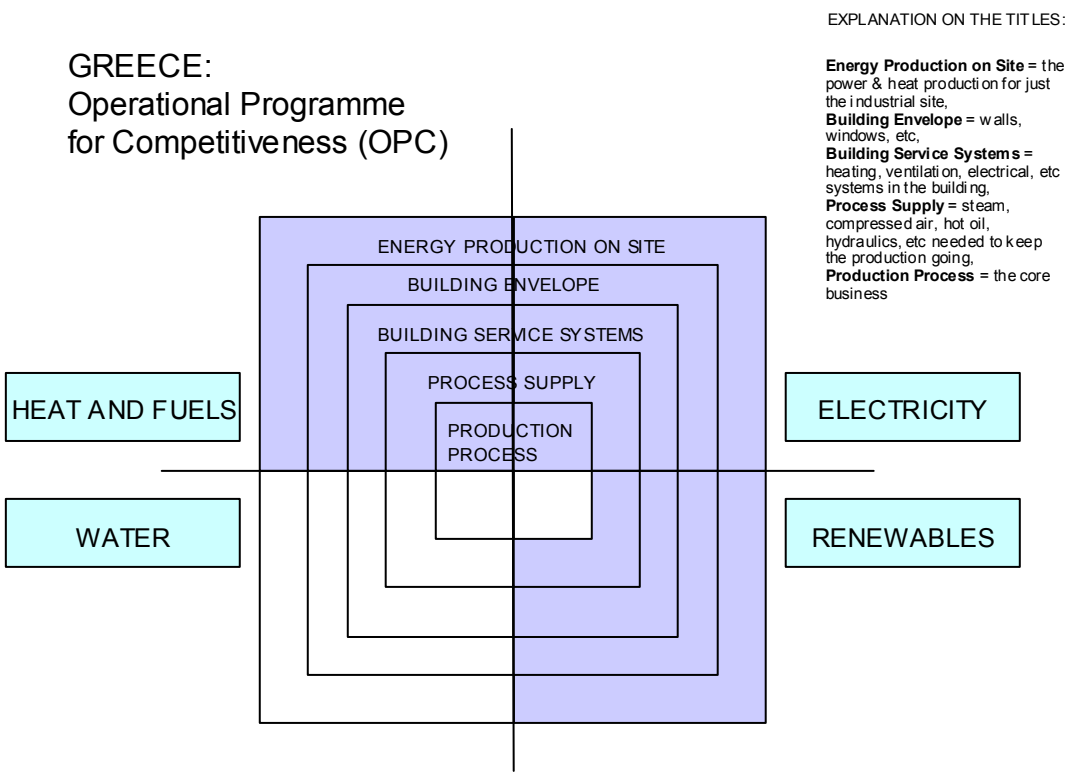

Figure 3.2 - OPC Energy Audit Model Map

3.1.6 Auditor tools

The OPC IMAs energy auditors who would implement a finished project hand over energy audit have as guiding reference the energy analysis data that are presented in the project administrative forms already elaborated within OPC project management procedures. Such a tool would force IMAs auditors to produce directly comparable results with energy data indices, already calculated by the project consultants-auditors during the proposal stage. Such a cross-check comparison is elaborated through the use of objective energy bill data analysis, after project implementation and the standard mathematical formulas already used from project consultants at the proposal stage for the calculation of the investment proposal evaluation criteria (e.g. mathematical formulas for the calculation of primary energy savings, specific energy consumption, environmental impact). All the necessary reference is included in the official OPC Guide for Energy Investment proposals as well as the official OPC central management services and IMAs guidelines. Specific spreadsheets may be used to automate necessary analytical calculations for IMAs energy auditors.

The documentation included in the mandatory Energy Audit Regulation (EAR) is necessary to be followed by the auditor, both for walk-through and diagnostic audits, at the proposal stage of a private OPC energy investment. EAR includes model step analysis, standard audit report contents and structure, model audit data sheets, exemplary energy consumption analysis graphs and pies, definitions, units standard regression analysis techniques and basic mathematical formulas. Special technical software tools, are optional and selected from the respective international market (usually for building and process energy analysis or general statistical analysis and not dedicated to the audit analytical process itself).

3.1.7 Training, authorisation and quality control

The specifications for the eligibility of energy auditors to apply, in the near future, the new Energy Audit Regulation (EAR) for OPC energy project implementation (as well as for all energy audits within the foreseen building energy certification and public sector energy management legislation and programmes) have been included to a draft Ministerial Decision to be issued shortly. Up to date any interested technical consultant, not involved in OPC administration and operational management process is free to perform energy audits to support an energy investment proposal. The draft Decision auditor specifications took into account the necessity of a formal establishment of a new institution, this of the authorised Energy Auditor who is allowed to perform energy audits after his accredited participation in a special record of energy auditors. Energy audits are divided for this purpose in the two categories, taking into account the kind of audited systems and equipment as well as the respective energy loads:

Electrical Energy Audits, for equipment or systems that produce, convert, transfer, distribute or consume electrical energy or for electrical loads auditing.

Thermal Energy Audits, for equipment or systems that produce, convert, transfer, distribute or consume thermal energy or for thermal loads auditing.
Energy auditors are to be accredited and recorded separately for electrical and thermal energy audits, or even for the complete energy audit of a site which comprises both the above categories, according to their certified qualifications.
Energy audits are also divided in different classes according to the magnitude (N) of the total electrical or thermal power, of the audited system, as presented in Table 3.1.1

Table 3.2 - Division of Energy Audits

	Energy Audit Category	
Energy Audit Class	**Electrical**	**Thermal**
Class A	$N \leq 250$ kW	$N \leq 500$ kW
Class B	$250 \leq N \leq 1,000$ kW	$500 \leq N \leq 2,000$ kW
Class C	$N > 1,000$ kW	$N > 2,000$ kW

Energy auditors are also classified and recorded in relation to the above division according to specific criteria and experience. The introduction of an energy auditor for both electrical and thermal energy audits is allowed on the basis of his qualifications. Energy audits of Class C must be effected only by specific Energy Auditing Bureau's and not by individual auditors. Every Energy Auditing Bureau should employ certified energy auditors of adequate qualifications for Class B and C energy audits of any category.

The following qualifications are taken into account for the initial introduction of a candidate energy auditor to a specific category and class of the record of accredited energy auditors:

- The type of the first degree of the formal higher (university level) education (e.g. Diploma of Mechanical - Electrical - Energy Engineer, Degree of Energy Technologist)
- Any formal postgraduate studies and/or specialisation/training courses in the energy conservation and energy auditing - management field. Formal postgraduate studies should be at the Master of Science level and training courses should have duration above 300 hours.
- The certified working experience in energy systems - services topics and especially in topics relevant to the record category of audits where the auditor is to be introduced.

For the direct introduction of a candidate in Class C energy audits record, the extra prerequisite is to have effected at least 2 energy audits of Class B (the one at least of an extended - diagnostic level) or at least 4 energy audits of Class A (the one at least of an extended - diagnostic level)

Table 3.3 summarises the requested qualifications for the eligibility for introduction of an energy auditor to a certain Class of the energy auditors' record.

Table 3.3 - Eligibility of energy auditors (per energy audit Class) according to draft MD

Higher Education Degree	**Certified Working Experience (CWE)**	**(CWE) + M.Sc. or Profess. Training ≥ 300 h in energy topics**	**(CWE) + PhD in energy conservation topics**	**(CWE) + Number of performed Energy Audits**
Dipl. Mechanical Dipl. Electrical Dipl. Naval Engineers (Technical Universities)	6 - 8 years (A) 9 - 11 years (B) 13 - 14 years (C)	5 - 6 years (A) 7 - 8 years (B) 11 - 12 years (C)	3 -4 years (A) 5 - 6 years (B) 8 - 9 years (C)	
Dipl. Chemical Dipl. Mining Engineers (Technical Universities)	7 - 10 years (A) 10 - 12 years (B) 14 - 15 years (C)	6 - 8 years (A) 9 - 10 years (B) 12 - 13 years (C)	4 - 6 years (A) 6 - 8 years (B) 9 - 10 years (C)	Relevant Class years minus (-) years :
Other Dipl. Engineers (Civil, Architectural, Planning etc.) (Technical Universities)		7 - 8 years (A) 9 - 10 years (B) 13 years (C)	5 -6 years (A) 7 - 8 years (B) 10 years (C)	1: for up to 2 audits
Related Scientists (Physicists, Chemists, Agriculturists etc.) (Universities)		8 years (A) 10 years (B)	6 years (A) 8 years (B)	2: for up to 4 audits
Energy Technologists (Technological Inistitutes)	8 years (A)	7 years (A) 9 years (B) 13 years (C)	5 years (A) 7 years (B) 10 years (C)	3: for more than 4 audits
Mechanical , Electrical, Naval Technologists (Technological Inistitutes)	9 - 10 years (A)	8 - 9 years (A) 10 - 11 years (B)	6 -7 years (A) 8 - 9 years (B) 11 - 12 years (C)	

The following documents could prove the working experience of a candidate energy auditor in energy system - energy conservation topics:

- Employer certificates stating the kind and degree of involvement of the candidate auditor in energy related issues (e.g. technical studies, commercial services, energy surveys - audits etc.)
- Lists of energy projects effected and/or co-ordinated by the candidate
- Professional registration and higher education degree certificates
- Training certificates
- Copies of energy audit reports elaborated by the candidate.

The aforementioned documentation would be necessary for the initial introduction of the candidate to the record of energy auditors after the approval of his formal request for registration from a special Advising Committee for Energy Auditors appointed by the Minister of Development. The Committee will consist of representatives of the Government (MIDE, Ministry of the Environment), of CRES, of the Technical Chamber of Greece and 3 well-respected energy experts (one at least University professor).

The Committee also would manage the status and upgrading of the record of energy auditors and inspect all relevant training programmes designed and submitted by different energy organisations. It finally would advise the MIDE administration on possible complements and/or alterations of the institutional framework for energy audits. The Committee would convene three times a year and assess any past 4 months candidate requests for registration, extension or upgrading in a Class or Category of Energy Audit.

The Minister of Development would have the authority to alter any decision of the Committee, and discard the request of a candidate energy auditor after having consulted the Committee. The records of accredited energy auditors would be kept in the Division of Renewable Energy Sources and Energy Conservation of MIDE.

3.1.8 Monitoring

OPC incorporates a monitoring procedure similar to the one that has been applicable during the previous period operational programme, the OPE. After the completion of each project financed from OPE, the Intermediate Agents energy auditor monitored the performance of the project for at least three months. The results that have been collected from that monitoring process (energy consumption, production, etc), have been collected, processed and compared to the estimated energy targets of each project . A follow-up report has been produced from that procedure which described the real energy performance of a particular project and the degree of energy target achievement.

The three months period of monitoring sometimes is not adequate enough to produce solid results about the actual performance of each implemented energy project. In such case the monitoring period could be extended as long as the auditor would justify that such an extension would be necessary but no longer than a year.

The results from each project, within the previous OPE monitoring procedure, were collected and forwarded to MIDE by the Intermediate Agent of OPE (IAOPE) at regular time intervals so there is an ability of feedback and correcting actions. A similar process is valid for OPC. An Integrated Informative System (IIS) has been developed for OPE and OPC as well, where the whole data related to the progress of the whole programme is kept. Access to IIS is available to MIDE central management services, to Intermediate Agents and to the supervising services of the Ministry of Economy so that all the factors concerning the course of the programme are readily available to all the administrative authorities.

3.1.9 Auditing volumes

This paragraph refers to the audited volumes within the previous OPE programme since the actions of OPC have recently started and no concrete and representative results have been produced yet. The IIS information system that has monitored all the actions of the OPE programme has been updated with cumulative results until the end of June 1999. The outcome of these results shows that 83 projects from the OPE Measure 2.2, 124 projects from OPE Measure 2.3 and 36 projects from OPE Measure 3.2 had been accomplished by that date. The IAOPE Agent project hand-over energy audits have been implemented to all of these projects as it was foreseen for the hand-over procedure of the programme. Measure 2.2 refers to private investments for energy saving, co-generation and conventional fuel substitution either with LPG or Natural Gas in the industrial and service sectors. Measure 2.3 refers to the same type of investments but only performed from SMEs. Finally Measure 3.2 refers to RES investments. The distribution of the projects within the three Measures of the OPE 1994-1999 programme is presented in Figure 3.3 :

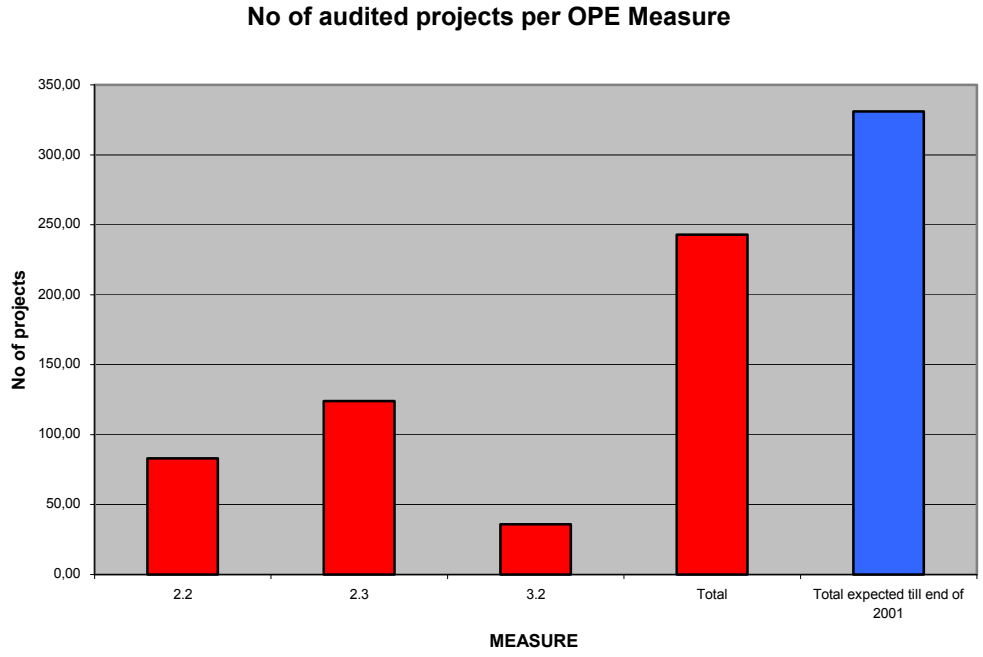

Figure 3.3 - Number of Audited Projects distributed to the three Measures of OPE 1994-1999

A more detailed presentation by sector of all the projects and therefore audits, implemented within the Measure 2.2 related to energy efficiency in existing business sites, cogeneration and fuel substitution investments is presented in Figure 3.4 :

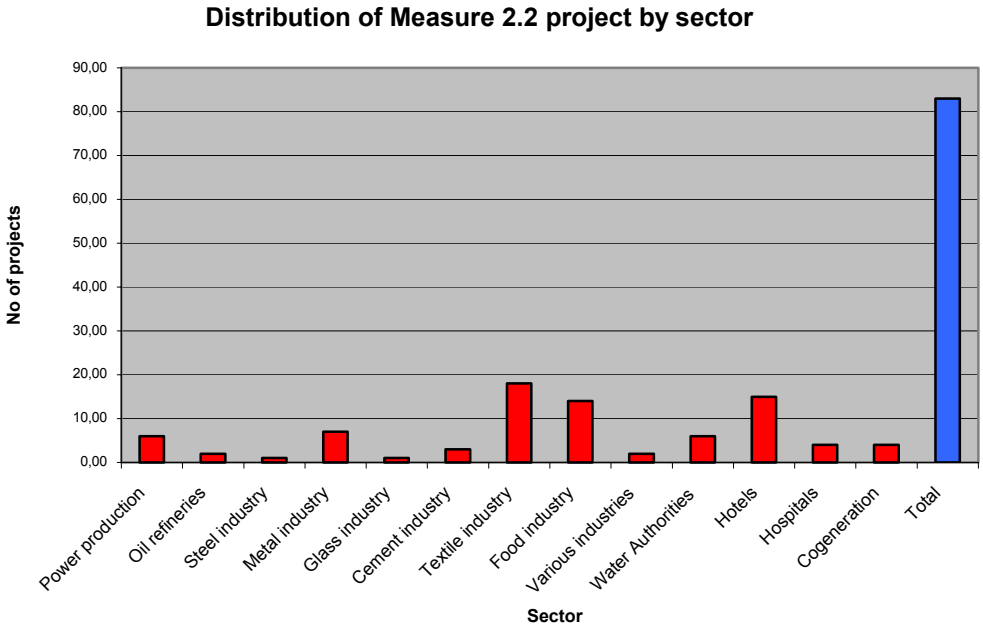

Figure 3.4 - Energy Saving projects & audits by sector of OPE Measure 2.2

3.1.10 Results

The resulting annual primary energy savings per sector according to the project hand-over audits within OPE Measure 2.2. are presented in Figure 3.5:

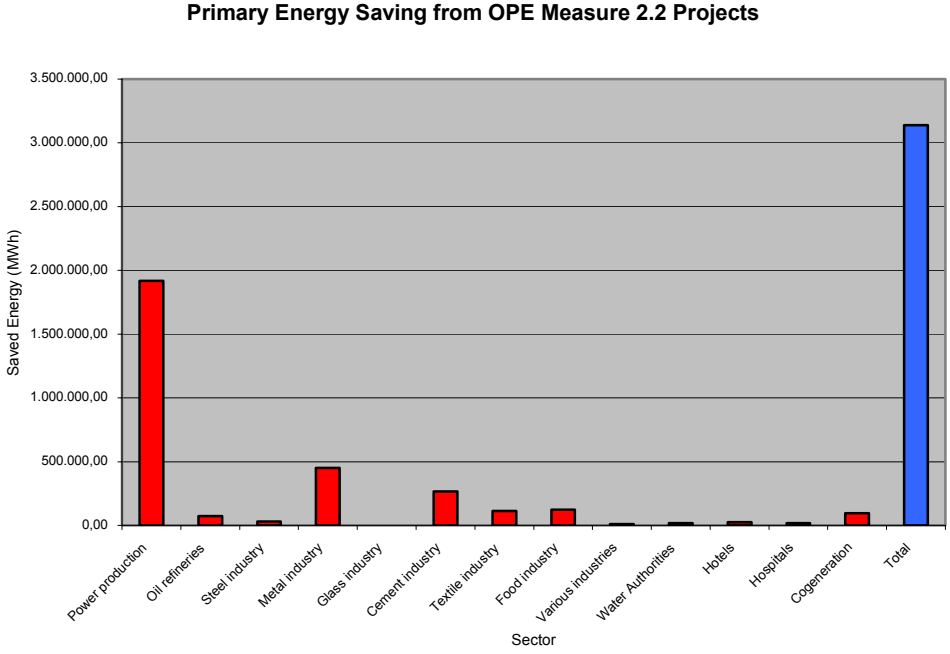

Figure 3.5 - Annual Energy Savings per sector from OPE Measure 2.2 projects

A comparison of the contracted project results, regarding annual primary energy savings, from project hand-over audits, which were already implemented until the end of June 1999, with the estimated results from these project proposals, is shown in Table 3.4, for each of the OPE Measure 2.2. :

Table 3.4 - Annual primary energy savings for contracted projects of Measure of OPE 1994-1999

OPE Measure	Estimated annual primary energy savings (MWh)	Audited annual primary energy savings (MWh)
2.2	2.965.650	3.140.178

It can be concluded that the energy savings from the contracted Measure 2.2 projects were underestimated during the proposal stage of the projects.

3.1.11 Evaluation

The new OPC 2000-2006 has just begun and is now at the process of the first evaluation of the submitted proposal under the OPC first call for proposals. Therefore there is not possible to evaluate its results yet. On the other hand, it is very important to evaluate at this point the OPE 1994-1999 programme results, since it has been just completed.

OPE, according to the programme evaluation documentation gave a very good incentive for the accomplishment of many projects that are related to energy conservation and to conventional energy substitution from renewable energy sources. Under this context OPE must be characterised as a successful programme. The major evaluation remarks after the completion of OPE are the following:

- Actions related to major energy projects and implemented from relatively well-organised institutions, like Public Power Corporation (PPC) and Public Gas Corporation (DEPA), were completed satisfactorily.
- The proposed overall programme energy targets were proved realistic and were achieved in a great extent.
- Actions implemented by the private sector presented deviation from the original overall targets. This overall deviation was positive for the investments related to RES applications, since the investors shown a great interest and implemented many projects, even more than the initially expected, especially for electricity generation. The overall deviation was negative for investments related to energy saving and especially CHP since the incentives were not strong enough for the investors to implement as many projects as expected from the programme administration side.

The major factors that influenced the success of OPE were the following:

- OPE 1994-1999 was a highly specific integrated programme which was implemented for the first time in Greece. For this reason some of the projects were not accomplished to the optimum way and some project specific targets were not achieved. The auditing process was proved satisfactory as far as the energy audit at the end of the project (hand-over) is concerned. On the other hand it was proved that many investors had not implemented a thorough energy audit procedure before the start of project (proposal stage) so they did not have a clear and realistic picture of the energy consumption of their plant, hotel, etc. In this case the comparison of the energy consumption before and after the implementation of the project was difficult and a lot of assumptions were needed in order to obtain a decent result.

- Before the beginning of OPE implementation there was no integrated national strategy regarding RES and RUE and therefore a lot of projects (especially related to RES and CHP) could not be implemented due to the absence of flexible legal framework.

- The decrease of low international fuel prices had resulted in a loss of potential benefits from investments that would result to energy savings. So the investors did not present the expected interest for this kind of projects.

3.1.12 Observations and future plans

The OPE was completed at the end of 2001. The experience gained from its implementation is used in order to improve some regulating issues regarding the implementation of the new OPC 2000-2006:

Maturity of actions : Today the conditions are more favourable for the application of an integrated policy in the area of energy and natural resources management.

Starting time for the various actions : The experience from OPE and the acquired infrastructure permits quicker time for the publication of OPC calls for proposals of the various Measures for the support of energy investments.

Economic feasibility of the investments : The demand for some type of energy investments during the OPE programme shows the factor of economic feasibility and its relation to the subsidies received. Therefore a careful study of the economic effectiveness of the energy investments that will be supported from OPC is required.

Monitoring procedure : The experience from the monitoring of OPE plus the improved guidelines and specifications of European Commission services result to an improved monitoring system for OPC.

3.2 CRES Energy Bus

Since 1990, the Centre for Renewable Energy Sources (CRES) uses the facility of the Energy Bus to perform energy audits of industrial and tertiary (commercial/public) sector end-energy user sites. The application of well organised energy auditing activities has been dictated from the ascertainment of the need to promote energy efficiency policy and applications in Greece taking into account the local circumstances where adequate energy indices and data for all final consumption sectors is still missing.
Since 2000, the facility of Energy Bus has been incorporated to the CRES Laboratory of Evaluation of RES & RUE Technologies, to be accredited by EN 45001.

3.2.1 Goals

The goals of CRES energy auditing activities with the use of its Energy Bus infrastructure is the promotion of RUE/Energy Saving and the formulation of energy consciousness. The objective of CRES Energy Bus audits is the recording, through adequate on-site measurements, of final energy consumption per use, process, department or plant as well as the identification and quantification of thermal and electrical energy losses. After the energy recordings, a brief and a report follow regarding the results of energy measurements and the appropriate proposals for energy savings.

The subsequent benefits are the promotion of energy saving strategies and investments for the end-energy users as well as the extraction and analysis of useful data as a background for sectoral national energy policies.

3.2.2 Target sectors & auditing volumes

CRES Energy Bus auditing activities have focused both on the private and public industrial and building sectors. Table 3.4 presents characteristic projects of CRES Energy Bus, excluding the auditing activities within the OPE 1994 – 1999 projects:

Table 3.4 - CRES Energy Bus characteristic projects

Project Title	Project Target
1. Technical assistance to the Greek industry for the elaboration of energy balances (VALOREN Programme 1991 - 1992)	• 20 large industries and SMEs • Promotion of RUE & energy consciousness
2. Energy audits in buildings of Sofia-Bulgaria (Contract SYNERGIA - CRES 1993)	• 5 buildings in Sofia • Energy measurements
3. Energy audits in Greek food industries (Action I82 E.C. DGVII - OPET Network 1993 - 1995)	• 20 food industries in Attiki, Thessaloniki, Crete • Dissemination activities
4. Energy audits in Greek public health-care facilities (SAVE Programme and OPET Contracts)	• 8 large hospitals • 1 elderly care building
5. Energy audits in Greek public administration buildings (OPET Contracts)	• 5 prefectural & municipal buildings • CRES office building
6. Energy audits in Greek public educational buildings (OPET Contracts)	• 14 schools • 1 university
7. Energy audits in Greek hotels and domestic buildings (Government and third party contracts)	• 15 large hotels - resorts • 4 buildings
8. Energy audits in numerous industries from various sectors	• 23 agrofood industries • 11 metal industries • 5 textile industries • 3 ceramic industries • 3 chemical industries • 1 cement industry • 1 paper industry
9. Energy Audits in Greek Airports (Study for CAA 1998)	• 13 airports
10. Energy Audits in Public Buildings (OPC Programme Contract , 2001)	• Parliament • 5 Ministries • 4 Prefectures • 9 hospitals • 1 students hall • 1 sports complex • Rhodes Airport • University of Ioannina • National Radio Television • National Observatory • National Archeological Museum
11. Demonstrative participation in public events (Conferences, workshops, fairs, seminars - Greek Government, HELECO 93 & 95, CRES, NTUA, TCG)	• Throughout Greece

3.2.3 Administration

CRES Energy Bus audits are totally managed by the centre that is also the operating agent and employs trained and experienced technical experts as energy auditors. Table 3.5 presents the original management structure of CRES Energy Bus programme.

Table 3.5 - CRES Energy Bus original management structure

Responsible Person	Dedicated Activities
1. Energy Bus Manager	• Strategic, technical and financial management of the Energy Bus • Contacts with third parties • Energy audit results control
2. Data Acquisition and Results Assessment Manager	• Collection and processing of primary energy data • Planning of energy audits • Supervision of energy measurements
3. Measurements Technician - Energy Bus Driver	• Elaboration of energy measurements • Equipment & Instrumentation handling and maintenance • Energy databank updating • Energy Bus locomotion and maintenance

3.2.4 Implementing instruments

CRES Energy Bus audits are intended to support energy efficiency policy and programmes or unitary projects on a non-profit basis and have traditionally been co-financed, on a project basis, either by the European Commission energy related or regional development programmes and the associated government budget (e.g. EC VALOREN, SAVE, THERMIE, ALTENER, PHARE Projects), or by marginal private third party capitals and public administration in-house funds.

CRES Energy Bus has been often pointed out as a successful and objective energy efficiency diagnostic service in several government policy documents and declarations. The documentation has been addressed to the final end energy users and programme managers of the public and private sector. Energy Bus is one of the traditional pillars of CRES profile, constantly promoted and incorporated in the laboratory infrastructure of the centre. It is up-to-date the most structured energy auditing means of CRES and perhaps of the country. CRES has planned, the incorporation of Energy Bus infrastructure in different new voluntary and pilot demonstration schemes for energy efficiency in industry and the building sector (e.g. Voluntary Agreements with industrial branches, energy management and investments scheme for public building stock)

3.2.5 Energy audit model

Table 3.6 presents the energy auditing activities provided by CRES Energy Bus and the respective model procedure for each respective service package.

Table 3.6 - CRES Energy Bus model procedure

Service	Procedure
1. Walk-through energy audit (Energy consumption recording (Split of energy consumption per process - use, elaboration of energy balances, identification of energy losses, energy saving proposals)	• Preliminary contacts - Audit mandate - contract • Primary energy data collection - audit questionnaire (user general info, 3 year fuel and electricity consumption, process analysis, energy uses, databank feeding) • Primary energy data processing (energy consumption trends, last year consumption monthly variation, energy split per process-use, specific energy consumption indices) and planning of on-site 1-day walk-through audit • Walk-through method (presentation of Energy Bus and processed data, further on-site recordings and energy measurements) • Analysis of energy measurements and elaboration of technical report - check of the report • Databank updating and report hand-over •
2. Indirect determination of boiler efficiency and flue gas analysis (Excess air measurement, flue gas concentration (O_2, CO_2, CO, SO_2, NO_x, C_xH_y, smoke) and temperature measurements)	• Same procedure but only dedicated to boiler-burner, combustion and thermal loads data • Measurements
3. Measurement of electricity consumption parameters (Instantaneous or time standing measurements per phase and totals for tension, intensity, active - reactive power and energy, power factor)	• Same procedure but only dedicated to electricity supply and loads data • Measurements
4. Determination of heat losses via infrared thermography (distribution of surface temperatures in boilers, furnaces, steam and hot water circuits, building construction elements)	• Same procedure but only dedicated to construction-insulation data of audited equipment or element • Measurements
5. Flow measurements (Use of ultrasonic flow meters)	• Same procedure but only dedicated to circuit construction - fluid data • Measurements
6. Temperature, humidity, air velocity measurements (Use of portable instruments or inserted probes)	• Same management procedure but only dedicated to relevant services and room operation data • Measurements
7. Illuminance measurements (Use of portable luxmeters in interior spaces)	• Same management procedure but only dedicated to luminaire - lamps and room operation data • Measurements

3.2.6 Auditor tools

Relevant to energy auditing CRES Guidebooks and model Energy Bus audit reports have been prepared and traditionally used to guide the Energy Bus field auditor work. These guidelines have followed the state-of-the-art knowledge of international energy policy and standards organisations as well as the experience of foreign well established energy agencies and national programme administrators of well developed and industrialised countries (e.g. USA, Canada, UK, Germany, Netherlands etc.).

The guiding documentation of the official Energy Audit Regulation (EAR), presented in Chapter 3.1 is considered as a valuable tool, after 1999, for CRES Energy Bus management experts and field auditors.

3.2.7 Training, authorisation and quality control

The CRES Energy Bus personnel consists of experienced technical scientists who possess an adequate mix of working experience in energy efficiency issues, of thorough academic qualifications and of professional training targeted to energy auditing and management.

The first team of CRES Energy Bus has undertaken professional training by experts of NOVEM (NL), within the procurement procedure of the Energy Bus infrastructure (1991). Further training of potential auditors has taken place either at CRES or at the premises of other well experienced energy organisations (e.g. MOTIVA (FI)).

The formal issue of the draft Ministerial Decision on the specifications for the authorisation of energy auditors, as presented in paragraph 3.1.7 and the practical experience of CRES auditors, already gained through the involvement of CRES to the activities of Intermediate management Agent of OPE 1994-1999 will enhance the quality of the offered Energy Bus auditing services in the near future

Formal quality control procedures are foreseen from now on for Energy Bus audits, following the accreditation by EN 45001 of CRES Laboratory of Evaluation of RES&RUE Technologies, where Energy Bus infrastructure belongs since 2000.

3.2.8 Monitoring and evaluation

No monitoring and results evaluation process has been implemented up-to-date. The main reason for this, is a) that the Energy Bus audits have never been in practice incorporated to any integrated energy efficiency monitoring and targeting national, regional or sectoral programme for a certain target group and b) the historically low interest of end-energy users to adopt voluntarily energy management practices also influenced by the low supplied energy prices.

3.2.9 Observations and future plans

CRES Energy Bus audits may have a positive future if properly incorporated to integrated energy efficiency programmes. OPC 2000-2006 presents an occasion to use the Energy Bus infrastructure in Voluntary Agreements targeting industrial branches and the assessment of the energy saving potential and relevant project results in the public building sector under special energy investment management schemes

3.3 JMD 21475/4707/98 & Regulation for RUE in Buildings (KOXEE)

Since 1998, the Joint Ministerial Decision (JMD) 21475/4707 for the improvement of energy efficiency of buildings to limit CO_2 emissions aided by the issue of relevant guiding Ministerial Circulars (see chapter 1.2), instituted obligatory energy auditing activities for public buildings. In the public sector, energy audits must be coordinated by officially established Energy Management Offices and inspected by the already appointed energy managers of the respective public authorities.

Furthermore, the JMD 21475 has introduced building energy certification procedures which will involve energy auditing activities. Energy audits will be performed by independent officially authorized experts. The framework of building energy certification, is incorporated to the final draft of the new Regulation for RUE in Buildings (named KOXEE) which will be shortly issued (2002). The goals and contents of KOXEE have been instituted as well by the JMD 21475/4707/98.

3.3.1 Goals

The existing JMD 21475/4707 and future KOXEE provisions aim at the improvement of energy efficiency of the existing building stock and new building constructions, in the country, in order to decrease the environmental impacts from the operation of the building sector, in terms of CO_2 emissions, within an acceptable building life cycle. The improvement of building energy efficiency is perceived as an integral element for the upgrading of building quality, which must simultaneously assure acceptable indoor hygiene and comfort conditions.

The above goals are to be achieved through a set of technical, administrative and financial measures, which include :

- The establishment of Energy Management Offices (EMOs) and respective energy management procedures in the services of central and regional public administration and in public organisations
- The issue of KOXEE, a model building energy code, which sets the principles, the requirements, the methods, the proecedures and the calculation tools for the integrated energy efficient and environmentally friendly design of new buildings and retrofit of existing buildings via RUE and RES technologies and techniques.
- A mandatory building energy certification and rating scheme, as specified by KOXEE and supported by energy auditing activities. After the issue of KOXEE, every new building or energy efficient retrofit construction permit should be accompanied by an energy certificate the so-called Energy Identity Card (DETA). Each DETA should contain all necessary information regarding the building energy performance indices, as calculated during the building permit design process and as finally cross-checked by an independent energy audit, after the actual building construction and its operation for at least one year.
- Regular energy audits in large energy consumers of the tertiary public and private building sector
- Regular energy audits of central building heating, cooling and hot water installations
- The outsourcing of integrated energy services for energy efficiency investments in the building infrastructure of the public sector, through the introduction of Third Party Financing/Energy Performance Contracting mechanism

3.3.2 Target sectors & auditing volumes

The target group buildings are :

- The whole existing building stock and new buildings of the central, regional and local public administration as well as of public organisations.
- The whole existing building stock and new buildings of the residential and private commercial and services sector
- The industrial buildings of large companies and SMEs with building services not fed by industrial processes

Very small, semi-open or secondary use building constructions without energy demand for indoor comfort and no permanent building services, as well as buildings of special use (e.g. historical, religious, of dedicated specifications) are to be excluded from the general provisions of KOXEE

3.3.3 Administration

The building energy management activities in the public sector are to be administered and operated by the Energy Management Offices (EMOs) of every central and regional public service/organisation and the appointed to it building energy managers, according to the mandates of the JMD 21475/4707/98 and respective Ministerial Circulars. Each public EMO has to be incorporated at a high level within the organisational chart of a public service/organisation (e.g. in a Ministry's General Directorate of Management, in a Prefecture's Directorate for Planning, in a Municipality's Directorate of Technical Services & Environment). The EMOs authority is indicated by the following work tasks :

- Collection and recording of final energy consumption documentation (bills, invoices), quantities and costs (fuels, electricity), since 1992
- Data bank handling regarding the energy performance of managed buildings
- Coordination of regular energy auditing activities and care for energy benchmarking analyses
- Recording of building use profile data and of energy equipment operation and maintenance problems. Correlation of these data with energy consumption data
- Cost and time programming of feasibility and technical design studies for energy investments
- Monitoring and project inspection related to building energy efficiency
- Indication and introduction of the financial requirements for a new energy project within the official state budget allocated to the specific EMO administrative authority (e.g. Ministry, Regional or Prefectural Management, Board of public organisation)
- Care for the local reservation of special funds of EU or national origin for energy efficiency in buildings
- Promotion of TPF contractual procedures for major energy saving and capital intensive projects, especially for the public health-care sector (e.g. CHP in Hospitals)
- Coordination of the local building energy managers who are responsible for each building of the EMO administrative authority.

Building energy audits that will support the energy certification scheme, as this is specified by KOXEE, should be performed by independent experts authorised by the Ministry of Development and assigned by the building project proprietors or their legal representatives.

3.3.4 Implementing instruments

All the foreseen auditing activities are mandatory for new buildings as well as for existing buildings either for retrofit constructions or at the final building energy regulation and certification scheme stage (after 2004).

JMD 21475/4707 and KOXEE directly support the national energy efficiency and CO_2 abatement policy.

3.3.5 Energy audit models

The energy audits should follow in principle the model procedures of the Energy Audit Regulation (EAR) as already presented in paragraph 3.1.5. The model map of the general audit process is presented in Figure 3.6. Further adaptations of the EAR to KOXEE building energy certification scheme will follow.

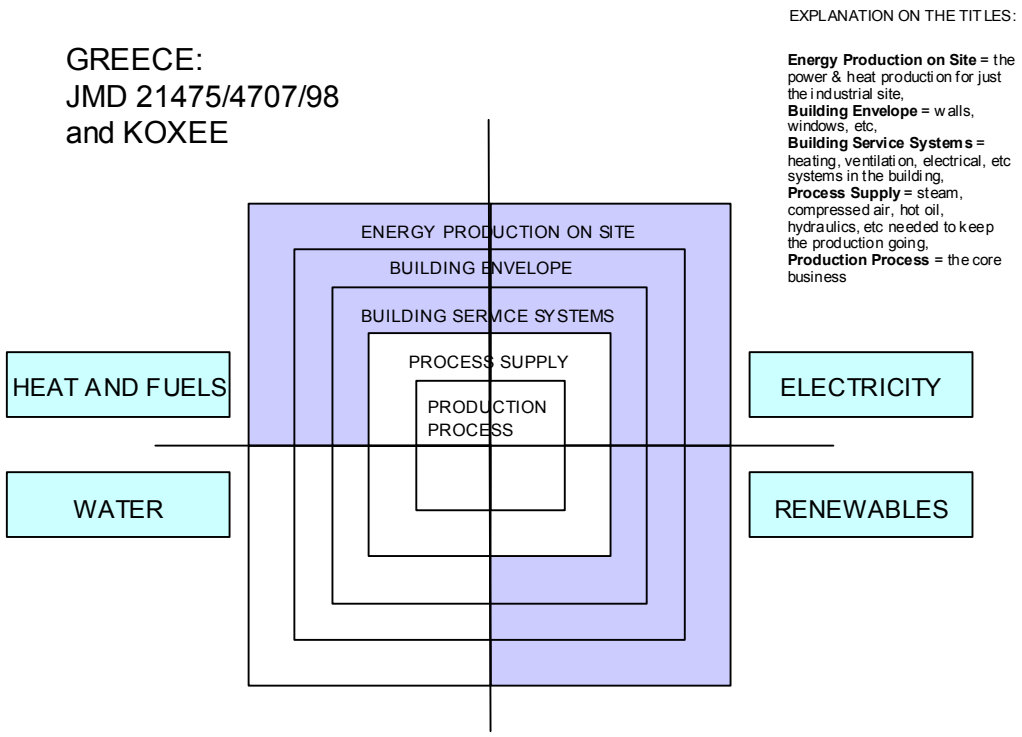

Figure 3.6 – JMD 21475 & KOXEE Energy Audit Model Map

3.3.6 Auditor tools

The EAR as a standard guiding document includes model step analysis, standard audit report contents and structure, model audit data sheets, exemplary energy consumption analysis graphs and pies, definitions, units standard regression analysis techniques and basic mathematical formulas. Special technical software tools, are optional and selected from the respective international market (usually for building energy analysis or general statistical analysis and not dedicated to the audit analytical process itself).

Relevant to energy auditing CRES Guidebooks and model CRES Energy Bus audit reports have been prepared and traditionally used to guide the independent field auditor work. These guidelines have followed the state-of-the-art knowledge of international energy policy and standards organisations as well as the experience of foreign well established energy agencies and national programme administrators of well developed and industrialised countries (e.g. USA, Canada, UK, Germany, Netherlands etc.).

A Greek version of a pilot software tool for energy audits in residential buildings, named EPIQR v.1, has been prepared, within a European research project of EC DG XII and is available from the Energy Conservation Unit of the Institute of Environmental and Sustainable Development Research of the National Observatory of Athens (NOA). The adaptation of such a tool to KOXEE energy certification needs may help the auditing process for residential buildings. EPIQR helps the field energy auditor and energy efficient retrofit designer to assess the general energy profile and indoor environmental quality of an existing residential building, to indicate necessary retrofit options and their cost and to optimise building energy consumption. EPIQR is equipped with objective analytical source codes (e.g. relevant to EN 832 building heat demand method) and adequate climate and building material and equipment databases.

3.3.7 Training and authorisation of auditors

Formal training cycles for the appointed energy managers-responsilbles have been foreseen, within planned training in overall energy management issues. Training in energy auditing concepts and related subjects has not yet been broadly implemented,. These training activities would be based on the pilot training programmes of CRES on the specialisation of engineers in the field of energy management and energy auditing .

The authorization process for the field building energy auditors would follow in principle the already mentioned in paragraph 3.1.7.

3.3.8 Monitoring and evaluation

The implementation of JMD 21475/4707/98 has just started in practice. The establishment of Energy Management Offices is still behind the set timetables. Up to now, over 600 energy local managers-responsibles have already been appointed to handle energy management activities in public buildings. A special questionnaire has been addressed from the Ministry of Interior, Public Administration and Decentrelisation (MIPAD) to all participating public authorities for energy data collection related to the situation of the building stock and the working space conditions, the energy use and equipment installed, the energy consumption (electricity, fuel) and finally the existing energy management framework in different administrative levels. Feedback responses have not yet been assessed and recorded.

3.3.9 Auditing volumes

The respective field auditing activities have just been planned.

3.4 Action Programme for Energy Efficient Public Buildings within CSF 2000-2006

In 2001, a targeted Action Programme, of the Ministry of Environment and CRES was announced. This programme aims at promoting the integrated energy efficient design in public building projects which will be proposed, financed and implemented within the EU 3^{d} Community Support Framework (CSF) 2000-2006 for the Regions of Greece. Energy auditing activities, to be performed by auditors, coordinated by CRES, are foreseen during the planned final (second) stage of this programme, in order to support and verify energy technology investments. Such investments have been planned for financial support through the OPC 2000-2006 via special support schemes which would incorporate the Third Party Financing (TPF)/Energy Performance Contracting (EPC) mechanism.

The initial (first stage) of the programme was incorporated in a research project, which is actually almost finished. The goals of the first stage of the programme were :

- The organisation and documentation of an information procedure addressed to public administration authorities which plan and manage public building infrastructure projects
- The assessment of the opportunities for the introduction and financing of the whole Action Programme into the Greek government Operational Programmes (e.g. Competitiveness, Environment, 13 Regions Development) within the 3d CSF 2000-2006
- The rating and final selection of existing or new public building projects for incorporation in the Action Programme
- The determination of the necessary support measures for the Action Programme

The first stage research project results have been presented in a report elaborated by CRES. A special MS-Access database has been also created, by CRES, to codify the received information and to show the potential of mature future buildings projects, which may be included in the Action Programme. The following data have been already recorded :

General technical and administrative information for 372 public building projects (new or retrofit ones) of central and regional public administration and public organisations. The building floor area is 700.000 m^2 and the total project cost is € 845.000.000. 262 projects have already been indicated as general proposals to different CSF OPs or Community Initiatives (INTERREG, URBAN) but without explicit energy efficient specifications. Among them are 110 educational, 29 health-care, 87 cultural and 8 administration-office buildings.

The Action Programme for Energy Efficient Public Buildings is to be implemented through its introduction to the financial and management mechanisms of one or more of the most related CSF 2000-2006 Operational Programme (OP) Measures & Activities, such as the Activities 2.1.1.and 2.1.4 of OP Competitiveness, with an estimated budget of € 30 Million regarding the implementation of special support schemes which would incorporate the Third Party Financing (TPF)/Energy Performance Contracting (EPC) mechanism for public building projects

4. Other Activities including Energy Audits

The recent institutional framework for energy and the environment in Greece promotes alternative or complementary commercial energy auditing activities to support environmental management and certification schemes (e.g., EMAS) as well as economic activities associated with intensive energy end-use or energy services provided by specialised companies (e.g. Energy Service Companies) (ESCOs) through novel financial mechanisms (i.e. Third Party Financing (TPF), Energy Performance Contracting (EPC).

4.1 Commercial audits for Eco - Management and Audit Scheme (EMAS)

EMAS purpose in Greece, is, as already set by the Regulation 1836/93/EEC the registration and official recognition of companies and organisations that possess, review and publish voluntary environmental management programmes. These programmes should be based on own specific targets for the improvement of the environmental performance of products, services and operations and should be managed within adequate and officially declared administrative structures. The environmental performance targets should focus mainly on the reduction of environmental pollution, on waste recycling and on energy savings.

Environmental policy and management programmes of the companies and organisations are verified through periodic environmental or Eco–Audits and are certified from independent accredited environmental inspectors. The auditing of energy issues is one of the elements of an Eco- Audit effected in a certain site. These issues are related to the site topography and operations, the air and heat emissions, the management systems and housekeeping practices related to the use of energy etc. Furthermore, the Eco-Audit procedure, similarly to the energy audit one test established objectives against common practice and provides a certain assessment report.

In Greece, EMAS implementation is co-ordinated by the Ministry of the Environment, which is responsible for the setting of an accreditation system for environmental auditors, the establishment of the authority for the registration of companies which participate to EMAS and the relevant information and pilot implementation activities. The accreditation of environmental auditors was assigned to the National Accreditation Council of the Ministry of Development and the authority responsible for the registration of a company or organisation to EMAS is the EMAS Committee of the Ministry of the Enviornment.

Greek SMEs of the diary, food and textile sectors have already participated to pilot EU programmes. Furthermore, specialised private consulting firms have already implemented pilot EU programmes for the promotion of EMAS to the industrial companies of northern and western Greece as well as to tourist facilities. Another group of pilot EMAS projects is financed from the Operational Programme for the Environment of MEPPPW within the CSF.

4.2 Commercial audits for TPF/EP contracting

Third Party Financing (TPF) of energy efficiency projects, is an opportunity for the energy end-user, company or organisation, to overcome capital investment and risk obstacles and successfully establish energy management procedures. Through a special contract, a third party, i.e. an Energy Service Company (ESCO), would undertake dedicated feasibility studies and the risk of implementing the necessary capital intensive energy saving investments, as well as the technical design, procurement and installation, commissioning and hand-over of the project and possibly the maintenance of major equipment installed. By this way, major energy savings are guaranteed and in turn can pay-back the energy efficiency project cost including the third party services within a mutually agreed time period. TPF contracts usually involve the elaboration of on site energy auditing activities as a part of the project feasibility process.

The pure ESCO market is still very limited in Greece, mainly due to the lack of a well-defined TPF procedure and potential actors role. Some pilot Greek case projects for TPF, mainly co-financed by the EU energy programmes (SAVE, ALTENER and THERMIE) and elaborated by CRES with reference to public administration buildings, hospitals and RES systems as well as the recent procedures followed from the Ministry of Development to establish a legal framework for TPF contracting, within the programme OPE 1994 - 1999, show that this reluctance can be altered.